

Children Treated at an Expeditionary Military Hospital in Iraq

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Objective: To describe the treatment of children at an expeditionary military hospital in wartime Iraq.

Design: Descriptive, retrospective study.

Setting: The 332nd Air Force Theater Hospital in Balad, Iraq, January 1, 2004, to May 31, 2005.

Patients: All 85 children (of 1626 total patients) evaluated and treated at the hospital during the study period.

Interventions: Indicated surgical procedures performed on children.

Main Outcome Measures: Age, sex, diagnosis, injury, operations, and complications for children during the study period.

Results: The 85 children (age range, 1 day to 17 years; mean, 8 years) represented 5.2% of all patients. Thirty-

four (61%) of the 56 children for whom sex was recorded were male. Injury was the diagnosis for 48 children (56%). Of these, the cause was fragmentation wound in 25 children (52%), penetrating trauma in 11 (23%), burn in 9 (19%), and blunt trauma in 3 (6%). The site of injury was the lower extremity in 18 children (38%), head in 11 (23%), upper extremity in 8 (17%), abdomen in 8 (17%), and chest in 3 (6%). Nontraumatic conditions had congenital, infectious, gastrointestinal, and neoplastic causes. During the study, 134 operations were performed on 63 children. There were 5 deaths.

Conclusions: Expeditionary military hospitals will encounter both injured and noninjured children seeking medical care. To optimize the care of these children, it will be necessary to provide the proper personnel, training, and equipment.

Arch Pediatr Adolesc Med. 2006;160:972-976

MODERN WARFARE OCCURS in territories with a civilian population, resulting in injuries to noncombatants, including children.¹⁻⁶ Sometimes, children are employed as combatants or used as human shields.⁷ Therefore, it is inevitable that military medical units will encounter injured children. Because local health care is often disrupted near sites of conflict, children with other problems also may seek care at military hospitals. Just as it is important for military medical services to recognize and prepare for traumatic injuries incurred by combatants and noncombatants, it is also important to prepare for medical illnesses that may be encountered.

United States and coalition forces entered Iraq in 2003 and were accompanied by medical personnel and facilities. Combat medical echelons of care are as follows: level I, battalion aid stations; level

II, forward surgical teams; level III, hospital facilities in the theater of combat; level IV, Landstuhl Regional Medical Center in Germany; and level V, Walter Reed Army Medical Center, Washington, DC.⁸

The level III hospitals in the theater of combat are the highest-acuity facilities available to civilian casualties, including children. The absence of adequate national medical facilities creates difficulty in discharging children from expeditionary military hospitals if they have ongoing medical needs.⁹ The lack of infrastructure, supplies, and personnel compromise the effectiveness of Iraqi hospitals. Early in the conflict, the decision was made to offer US military hospital care to injured civilians in instances of life-, limb-, and vision-threatening injury. In addition, on a case-by-case basis, the hospital commander could approve admission for children with medical needs beyond the scope of the Iraqi civilian medical system. This report details a 17-month experience with

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Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE SEP 2006		2. REPORT TYPE		3. DATES COVERED 00-00-2006 to 00-00-2006	
4. TITLE AND SUBTITLE Children Treated at an Expeditionary Military Hospital in Iraq				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Wilford Hall Medical Center, Department of Surgery, Lackland AFB, TX, 78227				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 5	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			



Figure 1. The 332nd Expeditionary Medical Support Air Force Theater Hospital in Balad, Iraq. The network of tents includes 3 operating rooms, which can each accommodate 2 simultaneous operations. The adjoining helipad is visible in the background.

children treated at a level III expeditionary military hospital in Balad, Iraq.

METHODS

This study is a descriptive, retrospective study, for which institutional review board approval was obtained from the hospital command section. All patients presented to the 332nd Air Force Theater Hospital in Balad, approximately 40 miles north of Baghdad. The facility consists of a series of tents, linked by corridors, and a concrete floor (**Figure 1**).

The structure includes metal containers used as operating rooms. In each of these 3 operating rooms, 2 operations can occur simultaneously, so that 6 procedures can be performed at a time. The hospital is capable of up to 24 intensive care unit beds and 80 ward beds, depending on how it is configured. A multinational staff of approximately 420 personnel enables surgical and medical care across numerous specialties.

The period studied was 17 months from January 1, 2004, through May 31, 2005. This period was chosen because an electronic record of all patients was initiated in January 2004 and the authors left the hospital in May 2005. Data were collected from the surgical logs of the hospital and reviewed retrospectively. The record included all patients presenting to the hospital for care. The diagnosis was determined by the admitting surgeon. Demographic data were obtained from patients and relatives, with assistance from translators, and recorded by the admitting nurse. Pediatric age was defined as being younger than 18 years. Data collected were age, sex, diagnosis, treatment, and complications. An *International Classification of Diseases, Ninth Edition (ICD-9)* code and Injury Severity Score (ISS) were assigned for all children. The ISS was calculated using ICDMAP-90 software (Tri-Analytics, Inc, Bel Air, Md). Statistical analysis was by χ^2 for distributions and unpaired, 2-tailed *t* test for numerical data.

RESULTS

The conditions of a total of 85 children were evaluated and the children were treated during the study period, representing 5.2% of all 1626 patients in the surgical logs and approximately 18% of the Iraqi civilians treated. Their age range was 1 day to 17 years (mean age, 8 years). Sex was

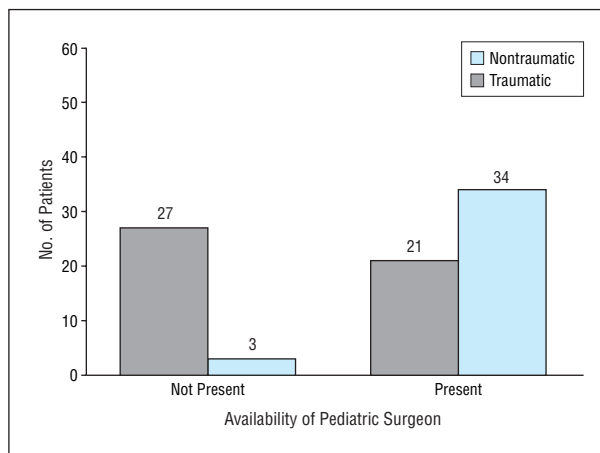


Figure 2. Children presenting to an expeditionary military hospital for traumatic and nontraumatic conditions during the 12 months before and the 5 months after a pediatric surgeon arrived at the facility.

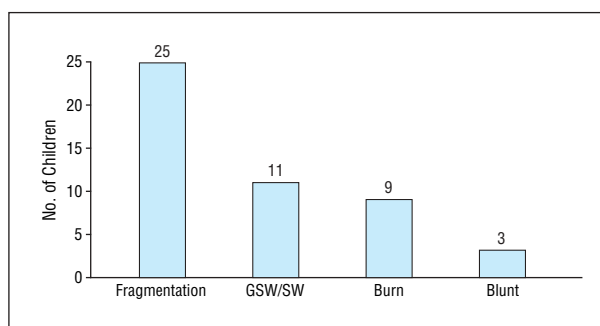


Figure 3. Mechanism of injury in 48 children treated at an expeditionary military hospital. GSW/SW indicates gunshot wound and stab wound.

recorded for 56 of the 85 children. Of these, 34 (61%) were male, 21 (38%) were female, and 1 child with intersexuality had indeterminate sex.

Overall, 48 (56%) of the 85 children were treated for a traumatic condition (ISS range, 1-29; mean, 8.5). The remaining 37 children (44%) were treated for nontraumatic diagnoses. From January 1, 2004, through December 31, 2004, when no pediatric surgeon was present, 3 (10%) of 30 children were treated for nontraumatic diagnoses. From January 1, 2005, through May 31, 2005, when a pediatric surgeon was present, 34 (62%) of 55 children were treated for nontraumatic diagnoses ($P<.001$) (**Figure 2**).

INJURIES AND OTHER CONDITIONS

The most common cause of trauma was fragmentation injury (25 [52%] of the 48 injured children) (**Figure 3**). This category includes improvised explosive devices, unexploded ordnance, indirect fire (mortars, rockets, and rocket-propelled grenades), mines, and blast injuries. Most of the children with fragmentation injury were injured in improvised explosive device attacks. Most of the 48 injured children had multiple sites of injury, with the most common site of primary injury being the lower extremity (18 children [38%]) (**Figure 4**).

Nontraumatic conditions were grouped into the broad categories of those having congenital, infectious, gastrointestinal and feeding, and neoplastic causes (**Table 1**).

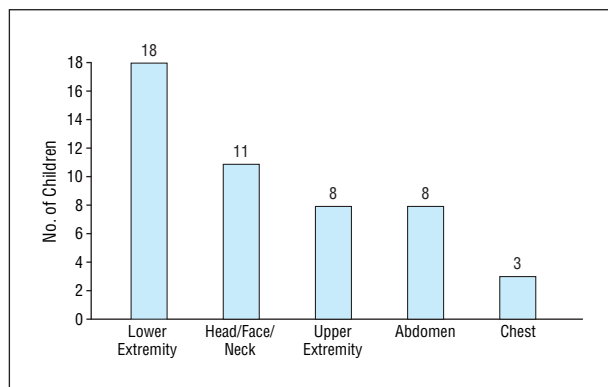


Figure 4. Primary site of injury in 48 children treated at an expeditionary military hospital.

OPERATIONS AND OUTCOMES

At least 1 operation was required by 63 (74%) of the 85 children examined at our hospital. A total of 134 operations were performed on 63 children (mean number, 2.1 operations per child). These represented 4.4% of the 3036 total operations recorded at the hospital during the study period. Forty-seven (98%) of the 48 children with traumatic injury required an operation. Only 16 (43%) of 37 children with a nontraumatic diagnosis required an operation ($P < .001$ compared with children with traumatic injury).

One hundred eleven operations were performed in 47 children with traumatic injury (**Table 2**). Most of these children required procedures at multiple sites of injury. The most common operation performed was skin or soft tissue wound care (which included irrigation, debridement, fasciotomy, escharotomy, skin graft, dressing change, and splint application). Twenty-three operations or procedures were performed on 16 children with nontraumatic diagnoses.

Three complications occurred during the study period. A 14-year-old child with a comminuted left femur fracture developed osteomyelitis. An 18-month-old child developed pneumonia after hepatoporojejunostomy for biliary atresia. A 3-year-old child presenting with pneumonia and malnutrition went into cardiorespiratory arrest when her endotracheal tube was dislodged, but she was revived with cardiopulmonary resuscitation.

There were 5 deaths during the study period. Two were the result of burns: a 10-year-old child with burns covering 65% of the total body surface area and a 2-year-old child with burns covering 40% of the total body surface area. Two deaths resulted from infectious causes: an 8-day-old newborn with neonatal sepsis and a 3-year-old boy with visceral leishmaniasis. The remaining death occurred in a 12-year-old girl with traumatic head injury who required tracheostomy and placement of a gastrostomy tube. She was transferred to a civilian facility where she asphyxiated when her tracheostomy became plugged with secretions. For the 3 children who died after injury, the mean ISS was 26.7, whereas the 45 children who survived their injuries had a mean ISS of 7.3 ($P < .05$). Thirty-day operative mortality was 6% (5 children) for the entire group of 85 children. There was 1

Table 1. Nontraumatic Diagnoses in Children*

Diagnosis by Category (ICD-9 Code)	No. of Children
Congenital (n = 22)	
Genitourinary (ambiguous genitalia [752.7], hypospadias [753.8], cryptorchidism [752.89])	3
Hernia (inguinal [550.9], ventral [553.2])	3
Vascular (228.01)/lymphatic (457.9) malformation	3
Craniofacial malformation (756)	3
CNS (encephalocele [742], meningomyelocele [741.93])	2
Thalassemia (282.49)	2
Cardiac (hypoplastic left heart) (745.3)	1
Biliary atresia (751.61)	1
Cystic fibrosis (277)	1
Spondylolisthesis (756.14)	1
Calcific keratopathy (366.8)	1
Spastic contractures (718.4)	1
Infectious (n = 7)	
Visceral leishmaniasis (085.9)	2
Pneumonia (486)	2
Neonatal sepsis (771.81)	1
Infectious diarrhea (009.2)	1
Otitis media (382.9)	1
Gastrointestinal/feeding (n = 5)	
Gastroesophageal reflux (530.81)	1
Rectal prolapse (569.1)	1
Aspirated foreign object (934)	1
Dehydration (276.5)	1
Failure to thrive (783.41)	1
Neoplastic (n = 3)	
Central nervous system (239.6)	1
Mastoid (239.2)	1
Maxillary sinus (239.1)	1
Total	37

Abbreviations: CNS, central nervous system; ICD-9, *International Classification of Diseases, Ninth Revision*.

late death when the child who underwent portoenterostomy died of liver failure 15 months after operation.

COMMENT

This report describes the care of children by an expeditionary hospital in Iraq. Our primary mission as a level III hospital was to provide evaluation, resuscitation, and surgical care to combat-injured troops. When stabilized, American troops were evacuated to the regional medical center in Germany. However, our facility experienced "mission creep" because of the presence of injured civilians, including children. Children additionally had dehydration and malnutrition, which contribute to increased mortality.¹⁰ After January 1, 2005, a pediatric surgeon was available and a broader range of nontraumatic conditions were treated in children.

Our experience mirrors that of other military medical providers in Afghanistan and Iraq in that fragmentation and blast injuries were the most common mechanisms of injury.¹¹ This is the typical pattern of injury in victims of improvised explosive devices and suicide bombers. Children are particularly vulnerable to unexploded ordnance and land mines.^{12,13} Blast and fragmentation devices produce multiple injuries over different regions of

the body. This is especially true in civilians, who lack the body armor worn by combatants.¹⁴ The injuries are a combination of penetration and crush of the soft tissues, often accompanied by fractures. The wounds are contaminated by fragments of the explosive device, vehicle shrapnel, clothing, and dirt. This requires extensive debridement and high-pressure irrigation to clear the wounds of debris and devitalized tissue. The fragments from improvised explosive devices and land mines produce a cone of injury larger than the entry wound.¹⁵ Injured children at our facility required multiple procedures for debridement of necrotic tissue, which delayed primary closure of the wounds.

The lower extremity was the most common site of injury, followed by the head. This differs from reports of injured adults, who sustain upper and lower extremity injuries more often than head injuries.^{8,11,14,16} This pattern may differ in children owing to their shorter stature and the proportionately larger size of the head. These factors make the head a more likely target of fragmentation devices. The third most common operation performed, after soft tissue wound operations and fracture fixation, was craniotomy for head injury.

Nontraumatic conditions were treated at our facility. Some children were referred by Iraqi institutions unable to provide the acuity of care required. Others chose to seek care at the American military base because of financial hardship, another family member being treated at our hospital, or referral after an encounter with American soldiers. Through the initiative and innovation of the hospital personnel, we were able to make the most of the austere conditions and limited resources, and we optimized the care provided for these children.

Some deficiencies in resources became manifest. There was a short supply of the smallest endotracheal tubes, sizes 3.5 to 5.0. Twenty-two- and 24-gauge catheters were quickly depleted following intravenous access in the hands of providers not accustomed to pediatric care. Finally, personnel experienced in pediatric anesthesiology, critical care, and critical care nursing were rare in our facility. The few individuals with this experience were often hard-pressed to cover prolonged periods when extremely ill children were present in the hospital.

Military pediatric specialists were dispersed throughout the theater of combat, assigned responsibility for adult combat troops. Once we discovered their presence, these providers represented a valuable resource for the care of children. This pool of pediatric expertise was also present during the first Gulf War.¹⁷ On one occasion, a pediatric anesthesiologist, who was assigned north of our location, traveled to our base to anesthetize a child for portoenterostomy. One pediatrician, officially assigned as the battalion surgeon for helicopter personnel on our base, participated in our weekly clinic. Another example of pooled resources was the case of the 2-year-old girl who underwent resection of a cervical cystic hygroma at our hospital and later received radiofrequency ablation treatment of her enlarged tongue at a different combat support hospital.^{18,19}

Our experiences have demonstrated several important lessons in the care of children in a war zone. Any

Table 2. Operations and Procedures Performed on Children

Operation	No. of Operations
For Traumatic Injuries	
Skin and soft tissue wound care	83
Fracture fixation	10
Craniotomy/cranioplasty	6
Exploratory laparotomy	4
Vascular exploration/repair	3
Thoracotomy	2
Bronchoscopy/esophagoscopy	1
Enucleation	1
Sural nerve graft	1
Total	111
For Nontraumatic Conditions	
Vascular access	4
CNS (resection of tumor, meningomyelocele repair, decompression)	3
Bronchoscopy	2
Excision of head and neck mass	2
Orthopedic fixation	2
Hernia repair	2
Computed tomography while under general anesthesia	2
Orchidopexy	1
Repair of rectal prolapse	1
Roux-en-Y hepatoportojejunosomy	1
Bone marrow biopsy	1
Thoracoscopic decortication	1
Ophthalmologic evaluation while under general anesthesia	1
Total	23

Abbreviation: CNS, central nervous system.

hospital near conflict should expect to receive civilian casualties, including children. The most common mechanism of injury in children is fragmentation injury, and the most common sites are the lower extremity and head. Fragmentation injuries are contaminated, resulting in necrotic tissue and requiring careful and repeated debridement. The neurosurgeons assigned to the facility were surprised by the excellent outcomes after penetrating head trauma in this setting. Local health resources may be so disrupted that children cannot be safely discharged until they are well enough to survive under the care of their families. To provide adequate care for children during war, expeditionary medical hospitals must prepare for them by providing the proper personnel, training, and equipment.

Accepted for Publication: May 8, 2006.

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Author Contributions: Study concept and design: Coppola. Acquisition of data: Coppola, Leininger, Rasmussen, and Smith. Analysis and interpretation of data: Coppola. Drafting of the manuscript: Coppola. Critical revision of the manuscript for important intellectual content: Coppola, Leininger, Rasmussen, and Smith. Statistical analysis: Coppola. Administrative, technical, and material support: Coppola. Study supervision: Coppola.

Acknowledgment: We thank Martin Eichelberger, MD, of George Washington University (Professor of Surgery and Pediatrics), Children's National Medical Center, and Safe Kids Worldwide (President and CEO), Washington, DC, for his advice and counsel during the preparation of this manuscript. We also acknowledge Mitchell Strait, of the Section of Trauma Services, Wilford Hall Medical Center (Trauma Statistician), for his assistance in calculating Injury Severity Scores.

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Poetry in Pediatrics

Emeritus Eavesdropping

Listening to 4 sophomores at lunch behind a lacy screen, arguing. "So, define schizoid and why we have 35 meds for 1 disease. That teacher is a Freudian relic with feeble antisense oligonucleotides."

I must be in that old minority who can no longer activate those chubby polyribosomes or totipotents, quite wistful over lost oligos, but still hopefully anticipating a durable concept of international peace, and perhaps the universal acceptance of our modern concepts of prose poetry. I am trying. And, I suspect that they knew I was listening.

Ed Spudis, MD